

Auralization of Vertical Take-Off and Landing (VTOL) in Urban Environments, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

The topic defines the problem as the development and demonstration of computationally efficient tools capable of modeling sound propagation in an urban environment for creating auralizations of UAM vehicles. The tools would be suitable for eventual integration with the NASA Auralization Framework (NAF).

The topic requires a set of modules to be delivered which will integrate with existing NAF infrastructure to efficiently find acoustic propagation paths in a complicated modeled urban environment and deliver them to the path traverser module. Delivered modules will include a pathfinder module, a source module, and a terrain module.

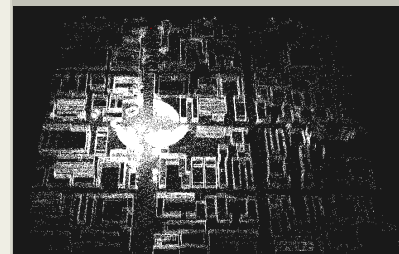
The pathfinder module will need to be capable of finding paths which represent all relevant physical acoustic wave propagation phenomena in the environment. The primary acoustic phenomena to be addressed within the pathfinder module are specular reflection and diffusion, with the ability to add atmospheric refraction in the future.

In addition to a pathfinder module, a method of integrating directional source radiation will be provided. The source model will be fed through a bank of FIR filters arranged spatially, allowing for frequency dependent directional radiation. Otherwise, the source model could be computed in the frequency domain, by computing the spectrum of each direction, applying to the spectrum of the source, and then generating the source audio via an inverse Fourier transform. Relevant benefits and detriments of each material will be reported on during the phase I effort.

An improved terrain model will be implemented as well, which allows for the storage of urban-scale complex environments. Work will be done to find high quality sources of data to populate the environments, including sources like the cityGML project.

Anticipated Benefits

- *Improved assessment community impact of urban aircraft related noise
- *Improved assessment of community impact of sonic boom
- *Improved assessment of large building internal noise
- *Improved acoustic evaluation method for airframe designers
- *Improved acoustic evaluation method for airframe customer
- *Improve shot detection system performance
- *Incorporation of aerial vehicles in the Army's Urban Multi-Modal Simulator



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Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Project Transitions	3
Images	3
Technology Areas	3
Target Destination	3

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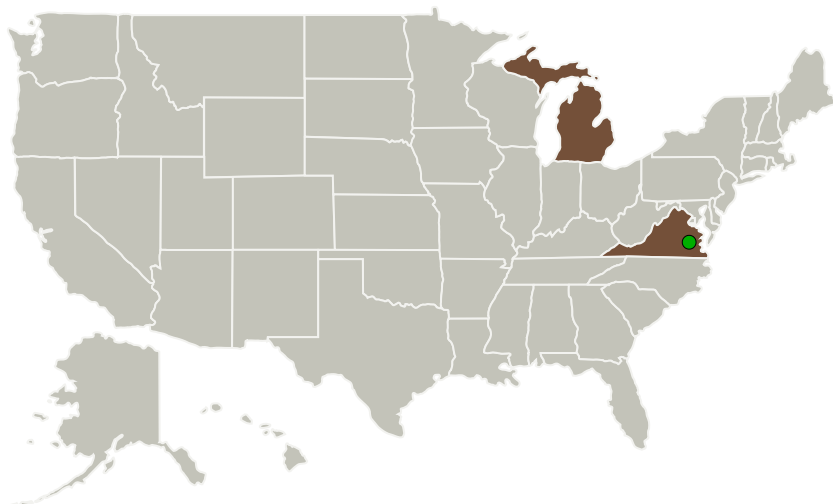
*Improved assessment of community impact of military range operations

*Improved acoustic evaluation method for product designers

*Improved acoustic evaluation method for customers

*Improved acoustic evaluation for civil and city layout engineers

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Great Lakes Sound & Vibration Inc.	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	Houghton, Michigan
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Great Lakes Sound & Vibration Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

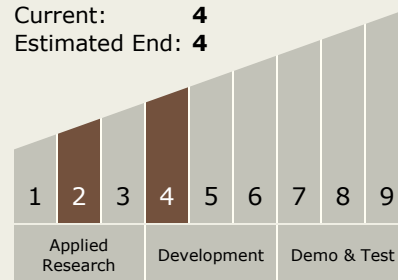
Jason L Kessler

Program Manager:

Carlos Torrez

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4



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Primary U.S. Work Locations

Michigan

Virginia

Project Transitions



July 2018: Project Start

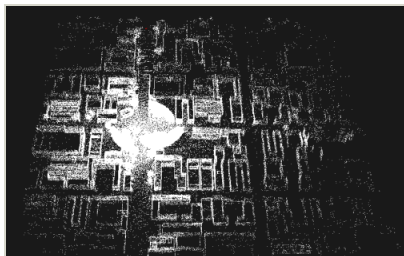


February 2019: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140940>)

Images



Briefing Chart Image

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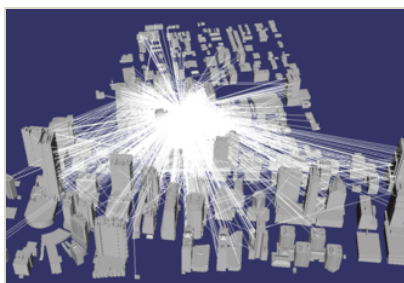
(<https://techport.nasa.gov/image/127802>)



Final Summary Chart Image

Auralization of Vertical Take-Off and Landing (VTOL) in Urban Environments, Phase I

(<https://techport.nasa.gov/image/133875>)



Final Summary Chart Image

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(<https://techport.nasa.gov/image/126489>)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - TX15.1 Aerosciences
 - TX15.1.4 Aeroacoustics

Target Destination

Earth